Performance of serial type buildings in Latvia

EGĪLS DZELZĪTIS
Engineer-electromechanic
Professor
RTU, Latvia
Tērbatas iela 76
Rīga LV-1001, LATVIA
dzelzisv@oic.lv

1967-1973 Engineer-constructor State Electromechanical Factory (VEF)
1973 Diploma, engineer-electromechanical
1982 Candidate of Technical Sciences
1992 Dr.sc.ing.
1994 Dr.hab.sc.ing

Summary

BMS matching to serial type buildings is provided.
Keywords: performance, energy, building, management, automation, cost, protocol.

1. Introduction

About 40% of the total energy consumption is used in the buildings sector in eastern and central Europe. A large proportion of residential dwellings are blocks of flats made of prefabricated concrete blocks or panels. Many of the buildings are in poor condition and need major renovation due to low construction quality. The energy losses from these panel-type buildings are very high and the potential for energy savings through thermal insulation and improvements to the heating systems are huge. If these measures are combined with general renovation of the building, which in many cases is necessary, the costs and the pay-back periods can be reduced significantly.

2. Heat substations for serial type buildings

In eastern and central Europe the energy consumption for heating purposes in residential buildings is often 2-3 times higher than that of similar buildings in Western Europe. Energy consumption for electricity and heating is in the order of 250-400 kWh/m^2 per year, whereas energy consumption for buildings in OECD countries can be some 150-230 kWh/m^2 per year. In Scandinavia, well insulated buildings have a consumption of 120-150 kWh/m^2 per year and so-called low energy houses (very good building envelope, very high levels of insulation, use of passive solar energy etc.) may have an annual energy consumption of 60-80 kWh/m^2.

Figure 1 shows average energy consumption for residential buildings in eastern and central Europe, the OECD countries, Scandinavia and for low energy houses. Large variations exist within each region depending on the date of construction and the technologies used.

Table 1

Serial type	*Construction period*	*Floors*	*Construction material*	*Main location*
1-316	*1957 – 1964*	*4 – 5*	*Lime and sand bricks*	*Riga*
1-318	*from 1964*	*5*	*Lime and sand bricks*	*Riga*
464	*from 1959*	*5*	*Lightweight concrete with expanded lay aggregate*	*Riga*
464A	*from 1961*	*5*	*Lightweight concrete with expanded lay aggregate*	*Riga*
467A	*from 1967*	*5*	*Aerated concrete*	*Riga*
467B	*from 1976*	*9*	*Lightweight concrete with expanded lay aggregate*	*Riga*

602	*from 1967*	*9*	*Lightweight concrete with expanded lay aggregate*	*Riga*
104	*from 1969*	*5 – 6*	*Lightweight concrete with expanded lay aggregate*	*Liepāja Ventspils*
103	*from 1969*	*5 – 6*	*Lightweight concrete with expanded lay aggregate*	*Valmiera*
119	*from 1980*	*6 – 9*	*Three layer panels*	*Riga (Zolitude)*

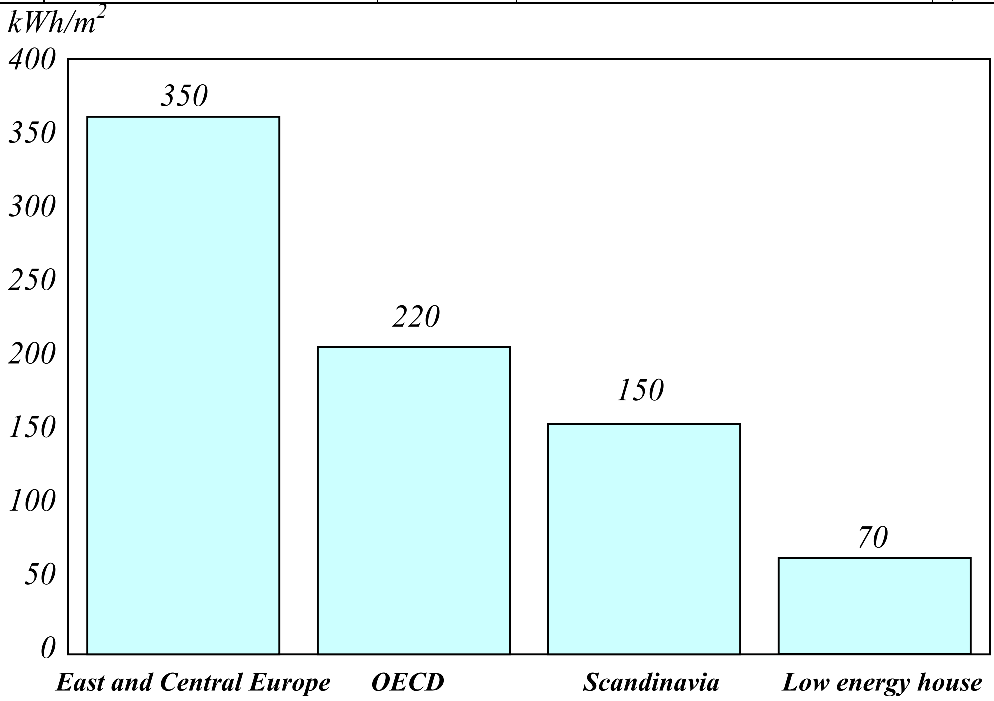

Figure 1 Average annual consumption for residential buildings

Properties of serial type buildings on the base of Riga District Heating retrofitting project for year 2001 (61 central heat substation replacement to 1003 individual heat substations) gives possibility to select individual heat substation's technological schema's type (two of them presented on fig.2 and fig.3):

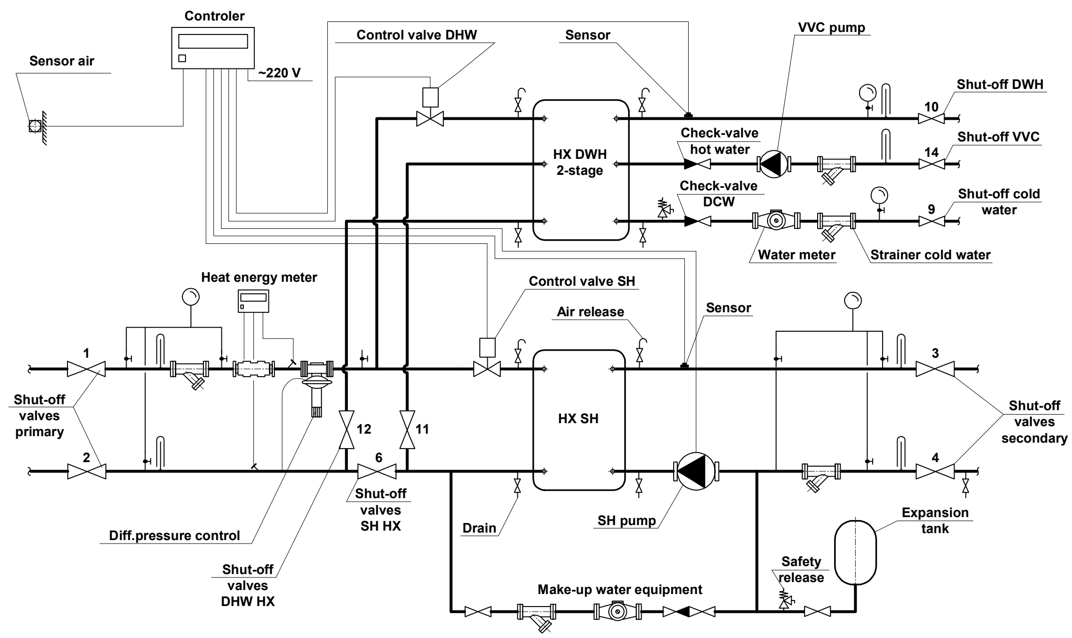

Figure 2. IHS: heating and two stage domestic hot water

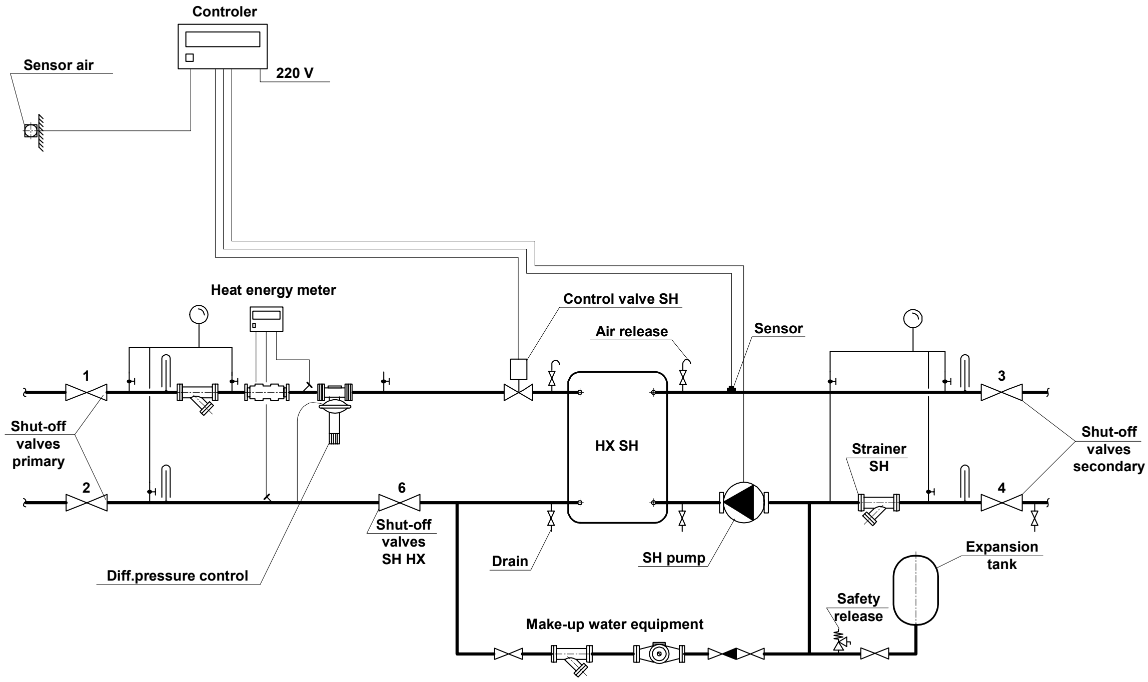

Figure 3. IHS: only heating

Implementation of automated individual heat substations points out the importance of total management problems in building management.

European pre-standards prEN 12170 and prEN12171 specifies requirements for providing documentation in respect of the O,M&U of systems in buildings.

3. Building management systems

The main goal of BMS is to provide desired IAQ (indoor air quality) in the confined space. There are some factors to be taken under consideration in process to provide desired level of IAQ:

1) accepted criteria of IAQ;

2) simultaneously with improvement of building envelope the necessary ventilation rate should be estimated, in investment calculations,

3) as for BMS implementation in buildings in Latvia the EN-12098-1; 1996E. “Control equipment for heating systems” has been adapted.

In reading this goal definite standards for control and communication are developed.

In part, this was accomplished by defining a number of Local Area Networks (LANs) interoperability.

This variety of LANs defines a range of options for any given project. Briefly, they are as follows:

Table 2. LANs

LAN	*Standard*	*Data Rate*	*Cost*
Ethernet	ISO/IEC 8802-3	10 to 100 Mbps	High
Arcnet	ATA/ANSI 878.1	0.156 to 10 Mbps	Medium
MS/TP	ANSI/ASHRAE	9.6 to 78.4 Kbps	Low
Lon Talk	n/a	4.8 to 1250 Kbps	Varied

Ethernet (ISO 8802-3)	Ethernet is a popular international LAN standard widely deployed in commercial applications. Ethernet is fast, running from 10Mbps to 100Mbps (fast Ethernet), and runs on a variety of media-STP, coaxial cable, or fibre optics. Like ARCNET, Ethernet requires a special chip to handle network communications.
ARCNET (ANSI/ATA 878.1)	ARCNET ® is a token bus standard, and devices typically support it using single-source chips that handle network communications. ARCNET can run on a variety of media at different speeds-from 150Kbps on EIA-485 (STP) up to 7.5Mbps over coaxial cable, STP, or fibre optics. Typically, ARCNET runs at 2.5Mbps over twisted pair.
MS/TP (master slave/token passing)	MS/TP is also unique to BACnet and is implemented using the EIA-485 signalling standard. This is a shielded twisted-pair (STP) LAN operating at speeds from 9.6Kbps to 76.0Kbps. This LAN type is low cost and particularly suitable for unitary controller communications.
Lon Talk	LonTalk is a proprietary technology developed by the Echelon Corporation and is the only LAN type that requires special development tools and a proprietary chip set to implement.
PTP (point-to-point)	PTP is unique to BACnet and provides for internetworker communications over modems and voice grade phone lines. PTP accommodates modern modem protocols (V.32bis and V.42) and also supports direct cable connections using the EIA-232 signalling standard. Speed is limited to from 9.6Kbps to 56.0Kbps.

As smooler integration of various building services comes to pass, facility monitoring and operation costs will fall. Here’s what you can expect:

- Higher quantity and quality of building operational data.
- Tighter evaluations and analysis.
- Better fiscal planning and operation of the facility.

As closer ties with utility providers are forged, more accurate energy provision and consumption data will be available to all. As an end result, there will be more cost-effective energy management and better utility and consumer cooperation.

As with standard DDC systems, buildings of all sizes are capable of being controlled. Control systems may be simple with very few devices or very complex. The BACnet standard is open-ended, yet has a stringent criteria for device compliance. Thus, it is economically viable for even small facilities to adopt control systems. As manufacturers develop products to fill all corners of the industry, more and more devices will appear to satisfy all building requirements and sizes, from the simplest to the most complex.

Development of standards for the European Union (EU) is the task European Committee for Standardisation, generally known as CEN (Comité Européen de normalisation). Members of CEN are EU and European Free Trade Agreement countries, a number of affiliate countries, and several European industry associations. The aim of CEN is “to draw up voluntary European standards and promote corresponding conformity of products and services in areas other than electrotechnical and telecommunications”.

Technical committee TC247 “Controls for Mechanical Building Services” in sector “Heating, Cooling and Ventilation” is working in area of controls and building management systems. To simplify complex structure of modern building controls, TC247 has created special three-level hierarchical model, which consists of management, automation and field levels.

The management level is where operator interface functions reside, as well as communication with controllers and dedicated non-HVAC systems such as fire alarm and security control, monitoring, alarm annunciation, trend logging, statistical analysis and centralised energy management functions. Usually these functions are carried out by PC workstation. The automation level is where real-time control functions are carried out: general-purpose programmable controllers. The field-level contains the devices that connect to sensors and actuators: unitary or application-specific controllers.

Table 3. CEN pre-standards

<table>
<tr><th>Level</th><th>ISO, ANSI</th><th>ENV</th></tr>
<tr><td>Management</td><td>BACnet
FND (DIN V 32735)</td><td>ENV-1805-1
ENV-1805-2</td></tr>
<tr><td>Automation</td><td>BACnet
PROFIBUS (EN 50170, Vol.2)
WorldFIP (EN 50170, Vol.3)</td><td>prENV 13321</td></tr>
<tr><td>Field</td><td>BatiBUS (NF C 46-620-623)
EHS
EIB (DIN V VDE 0829)
LonTalk</td><td>PrENV 13154-2</td></tr>
<tr><td colspan="3">CEN = European Committee for Standardisation
DIN = German standard
EIB = European Installation Bus
EHS = European Home System
EN = European standard
ENV = European pre-standard
FND = Firm Neutral Data Communication
NF = French standard</td></tr>
</table>

Therefore we have proceeded evaluation for BMS implementation in dwelling sector in Latvia especially in Riga. Investment part in such projects are BMS hardware, software and data communication system.

Incomes are indirect: decreasing of electrical heat energy and water consumption that finally decreases direct expenses.

BMS systems serves also emergency service, as result higher reliability of building technical systems simultaneously with detailed accounting. It gives increase of living standard and as a spin effect higher value of real estate on the market. Partial evaluation is provided for 50-ty flat building.

Initial BMS investment for one building is evaluated on sum 15000 USD, estimated savings on separate positions are estimated as follows:

- Electrical energy 10% or 500 USD
- Heat energy 15% or 5000 USD
- Tap water 10% or 200 USD

- Increase of reliability of building engineering systems 1250 USD

Total 6950 USD

As additional advantage of BMS in dwelling house are estimated increasing of active free time periods for dwellers giving chance for adult education and additional professional training. In such conditions payback period is expected in 2 years.

4. Discussion, Conclusions and Acknowledgement

The main conclusion of research under discussion is that implementation of modern technologies in district heating retrofitting projects in Riga city is less effective without simultaneously implementation of BMS for building groups.

The budget price of BMS is between 5-10% of all district heating retrofitting project price, but only implementation of BMS gives possibility during life cycle of building effectively utilise available advantages of Modern technologies.

Market value of equipped with BMS buildings in Riga is expected to increase in range 10-12%.

For effective confined space management in Latvia two demands should be realised:

1) relevant EN standards should be adapted;
2) BMS implementation is value if management intents are precisely formulated.

5. References

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